

SYSTEM ASSURANCE ANALYSIS

OF THE

CLEAN ACCESS PLATFORM

AND TEN TON HOISTS

AT

Pad-A, B

Baseline No.: 422.00
423.00

PMN: H70-1502
H70-1503

Revision Log

Rev.	Description	Date
New	Cancels and supercedes SAA09FTA3-001.	10/31/03

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TABLE OF CONTENTS

1	SYSTEM ASSURANCE ANALYSIS SUMMARY	4
1.1	FINDINGS.....	4
1.2	AREAS OF CONCERN	4
1.3	DOCUMENTATION LIST	4
2	SYSTEM DESCRIPTION.....	6
3	ANALYSIS GROUNDRULES	6
4	FAILURE MODES AND EFFECTS ANALYSIS	7
4.1	CRITICALITY ASSESSMENT.....	7
4.2	FMEA WORKSHEETS.....	12
4.2.1	Wire Harnesses, Cables and Connectors.....	12
4.3	COMPUTER INTERFACE ANALYSIS.....	43
Appendix A.	FAULT TREE AND HAZARD ANALYSIS	
Appendix B.	CRITICAL ITEMS LIST	

LIST OF ILLUSTRATIONS

Figure 1.	Clean Access Platform & 10-Ton Hoists Block Diagram	8
Figure 2.	Clean Access Platform and Hoists.....	13
Figure 3.	Clean Access Platform Assembly	14
Figure 4.	Clean Access Platform Hoist.....	15
Figure 5.	Ball Screw Drive	16

LIST OF TABLES

Table 1.	Finding Summary.....	4
Table 2.	Criticality Assessment Worksheet – PMN H70-1502	9
Table 3.	Criticality Assessment Worksheet – PMN H70-1503	11
Table 4.	Mechanical FMEA –Clean Access Platform	17
Table 5.	Mechanical FMEA – Ten Ton Hoists.....	21
Table 6.	Electrical FMEA – Ten Ton Hoists.....	22
Table 7.	Hazard Analysis Worksheet – PMN H70-1502 Clean Access Payload Bay Platform	A-4
Table 8.	Hazard Analysis Worksheet – PMN H70-1503 Pad RSS 10 Ton Hoist.....	A-5

1 SYSTEM ASSURANCE ANALYSIS SUMMARY

1.1 FINDINGS

Table 1. Finding Summary

	<u>Assessment</u>	
Reliability Criticality	Critical	
Safety Criticality	Critical	
	<u>Type</u>	<u>Quantity</u>
Critical Items	1	-
	1S	-
	2	-
1R Non-CIL Items	1R	4
Critical Flexhoses	1S	-
	2	-
Critical Orifices	1S	-
	2	-
Critical Filters	1S	-
	2	-
Hazard Reports	Accepted Risk	-
	Controlled	-

1.2 AREAS OF CONCERN

There were no Areas of Concern identified with this system.

1.3 DOCUMENTATION LIST

<u>Document/Drawing No.</u>	<u>Title</u>
80K51952	Launch Complex 39A Clean Access Platform (CAP) Installation
80K51971	Launch Complex 39B Clean Access Platform (CAP) Installation
80K51953	LC 39A Clean Access Platform Hoist Installation And Details
80K51970	LC 39B Clean Access Platform Hoist Installation And Details
80K51954	CAP Strongback Support
80K51972	CAP Strongback Support
80K51955	LC39A Stabilizer Assembly Clean Access Platform
80K52847	LC39B Stabilizer Assembly Clean Access Platform
80K51956	LC39A Assembly Clean Access Platform
80K52848	LC39B Assembly Clean Access Platform
80K51957	LC39A CAP Main Platform Assembly

<u>Document/Drawing No.</u>	<u>Title</u>
80K52489	LC39B CAP Main Platform Assembly
80K51958	LC39A CAP Intermediate Platform Assembly
80K52856	LC39B CAP Intermediate Platform Assembly
80K51966	LC39A CAP Hoist System Structural Support
80K52848	LC39B CAP Hoist System Structural Support
80K51981	LC39A CAP Intermediate Platform Side Members
80K52858	LC39B CAP Intermediate Platform Side Members
80K51982	LC39A CAP Intermediate Platform Details
80K52859	LC39B CAP Intermediate Platform Details
80K51959	LC39A CAP Center Finger Platform Assembly
80K52852	LC39B CAP Center Finger Platform Assembly
80K51960	LC39A CAP Side Finger Platform Assembly
80K52851	LC39B CAP Side Finger Platform Assembly
80K51963	LC39A CAP Finger Flip Platform Assembly
80K52854	LC39B CAP Finger Flip Platform Assembly
80K51962	LC39A CAP Drive Assemblies
80K52853	LC39B CAP Drive Assemblies
80K51961	LC39A CAP Rotating Wing Platform Assembly
80K52856	LC39B CAP Rotating Wing Platform Assembly
80K51964	CROSS MEMBER WELDMENT INTERMEDIATE PLATFORM CAP
80K52857	CROSS MEMBER WELDMENT INTERMEDIATE PLATFORM CAP
80K56705	LC39A CAP Rotating Wing Rotating Platform Assembly
80K56668	LC39B CAP Rotating Wing Rotating Platform Assembly
80K56706	LC39A CAP Rotating Wing Extending Platform Assembly
80K56669	LC39B CAP Rotating Wing Extending Platform Assembly
80K52984	LC39A CAP Storage Bracket Installation
80K52983	LC39B CAP Storage Bracket Installation
80K52987	LC39A CAP Anti-Back Drive Device
80K52982	LC39B CAP Anti-Back Drive Device
80K53239	LC39A & LC39B CAP Air Drive Tools
80K52676	CAP Jib Cranes & Handler Simulator
80K52526	CAP OMRSD
80K51973	LC39A CAP Schematic 480 VAC Power Installation
	LC39B CAP Schematic 480 VAC Power Installation
80K51974	LC39A CAP Schematic 120 VAC Power Installation
80K52545	LC39B CAP Schematic 120 VAC Power Installation

<u>Document/Drawing No.</u>	<u>Title</u>
80K51975	LC39A CAP Electrical Hoist Control Installation
80K52539	LC39B CAP Electrical Hoist Control Installation
80K51976	LC39A CAP Electrical Hoist Installation
80K52540	LC39B CAP Electrical Hoist Installation
80K51977	LC39A CAP Specification
80K51979	LC39B CAP Specification
80K51978	LC39A CAP Hoist Specification
80K51980	LC39B CAP Hoist Specification
KSCL-1792B-0514	LC39A & LC39B CAP Proofload Requirements
Q6173	Maintenance Instructions for the Clean Access Platform Hoist System, RSS
V6H66	Load Test and Maintenance Of The Clean Access Platform
V5136	Clean Access Platform Operation

2 SYSTEM DESCRIPTION

When the Clean Access Platform (CAP), PMN H70-1502, is deployed it can be used to provide access to the Orbiter, a payload, the payload canister, or Payload Changeout Room (PCR) open airspace. The primary purpose for the CAP is to provide access for removal of the payload bay protective liner and cleaning of the payload bay as required. The CAP is also used to provide contingency access to the payloads for cleaning or verification closeout. When the CAP is stowed, it is attached to the Payload Ground Handling Mechanism (PGHM) such that all the weight of the CAP is completely supported by the PGHM. In the stowed position, the CAP functions as PCR zero level flooring for the PGHM.

After the CAP has been disconnected from the PGHM, it can be raised and lowered using two 10-ton electric hoists, PMN H70-1503. The hoists are capable of being operated from either a fixed control station or a control station that is installed on the platform itself after the CAP has been disconnected from the PGHM. There is an E-Stop pendant located on each level of the PCR in addition to various platform limit switches all of which are designed to prevent the platform from experiencing inadvertent contact with the orbiter and/or a payload. The CAP also has platform extensions. The extensions are actuated using hand-operated air driven tools.

3 ANALYSIS GROUNDRULES

This analysis has been developed in accordance with NSTS 22206 and NSTS 22254.

The following additional groundrules and assumptions were used during this analysis:

- a. The main clean access platform is considered passive structure for the purpose of this analysis.
- b. The CAP is an appendage of the PGHM except when it is being moved from or to its stowed position and when it is being raised or lowered by its hoists. Therefore, the possibility of inadvertent contact with flight hardware as a result of CAP operations is only credible during these times and/or during extension/retraction of its extendible platforms. Reference PGHM analysis, SAA09FTAB31-001, for all other consideration of CAP related inadvertent contact with flight hardware.

- c. NASA Technical Standard number NAS-STD-8719.9 superceded document NSS/GO-1740.9. Although OMI Q6173, revision J dated April 01, 2003, still referenced document NSS/GO-1740.9, it is believed this situation will not create a problem prior to next update of OMI Q6173.
- d. Although OMI Q6173, revision J dated April 01, 2003, does not provide instructions to verify satisfactory operation of both the circuit breaker and the disconnect switch on the power and control distributor, it is believed this situation will not create a problem prior to next update of OMI Q6173.
- e. Design Engineering agreed the current depiction of Pad B full travel limit switch (FLTS) wiring on sheet 7 of drawing 80K52539 is in need of revision. Design Engineering initiated work order 530368A to accomplish the drawing update. Upon receipt of the updated drawing, Reliability Engineering will review the updated drawing and if necessary, update the SAA.
- f. Design Engineering agreed the current depiction of fixed control station wiring depicted on sheet 6 of Pad A drawing 80K51975 is in need of revision. Design Engineering initiated work order 530368A to accomplish the drawing update. Upon receipt of the updated drawing, Reliability Engineering will review the updated drawing and if necessary, update the SAA.
- g. Design Engineering agreed the current depiction of relay contacts CRR and KMAUX per Pad A drawing 80K51975 sheet 6 differs from the same relay contacts depicted by Pad B drawing 80K53539 sheet 6 and this situation should be corrected. Design Engineering initiated work order 530368A to accomplish the drawing update. Upon receipt of the updated drawing, Reliability Engineering will review the updated drawing and if necessary, update the SAA.
- h. Design Engineering highlighted that both pads currently utilize a shunt type E-stop and noted that use of a shunt type E-stop is no longer considered acceptable practice. It is expected that this situation will be included in the update being produced via Design Engineering initiated work order 530368A. Upon receipt of the updated drawing, Reliability Engineering will review the updated drawing and if necessary, update the SAA.

4 FAILURE MODES AND EFFECTS ANALYSIS

4.1 CRITICALITY ASSESSMENT

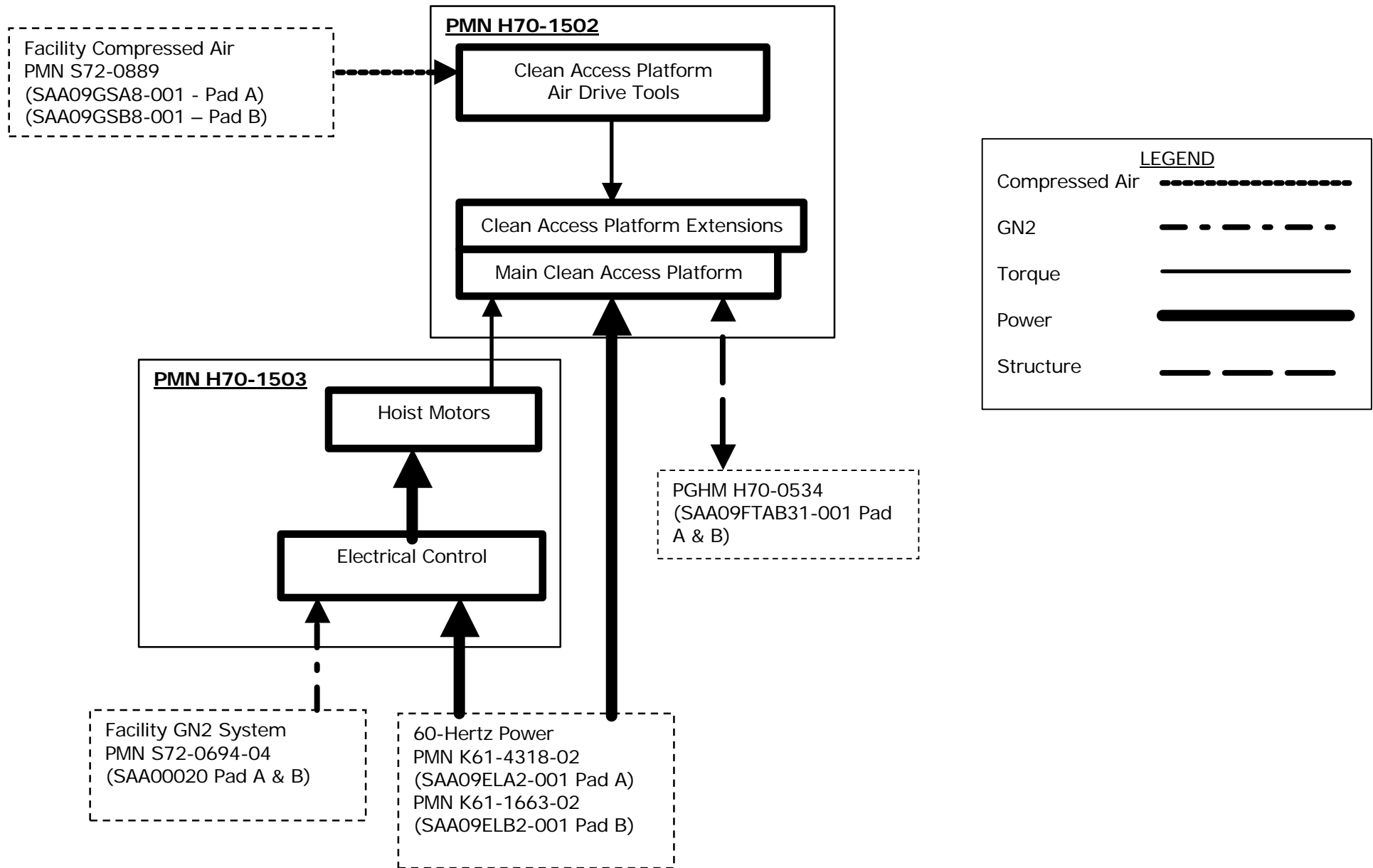


Figure 1. Clean Access Platform & 10-Ton Hoists Block Diagram

Table 2. Criticality Assessment Worksheet – PMN H70-1502					Pages 9 to 10
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform Location: Pad A & B					Baseline Number: 423.00
Input/ Output	Function	Time Period	Effect of Loss/Failure If Function Fails to Operate or Cease Operation on Time, Fails During Operation, and/or Prematurely Operates	Crit/ Noncrit	Notes
Input					
Torque (from H70-1503)	Force required to lift and lower main clean access platform.	As required	Loss of force used to lift and lower main clean access platform would result in loss of capability to lift and lower main clean access platform. Delay until hoist motors restored.	NC	
Compressed air (from S72-0889)	Source of power for air tools used to move platform extensions.	Continuous	Loss of power for air driven platform extension tools would result in lost of ability to move platform extensions. Possible operational delay.	NC	Ref SAA09GSA8-001 & SAA09GSB8-001
120VAC (from K61-4318-02 @ Pad A & K61-1663-02 @ Pad B)	Provides utility power for various users of main clean access platform and/or platform extensions after platform deployment.	As required	Loss of utility power for various users of main clean access platform and/or platform extensions after platform deployment would result in an operational delay.	NC	Ref SAA09ELA2-001 & SAA09ELB2-001
Structural support from PGHM, H70-0534	Completely supports the weight of the CAP while the CAP is in the stowed position and/or after the CAP has been positioned at the necessary location to support processing operations.	CAP stowed	Loss of structural support from PGHM could result in loss of load and subsequent loss of life and/or possible loss (damage) to vehicle/payload.	C	Ref SAA09FTAB31-001

Table 2. Criticality Assessment Worksheet – PMN H70-1502					Pages 9 to 10
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform Location: Pad A & B					Baseline Number: 423.00
Input/ Output	Function	Time Period	Effect of Loss/Failure If Function Fails to Operate or Cease Operation on Time, Fails During Operation, and/or Prematurely Operates	Crit/ Noncrit	Notes
Operator input	Manipulates system controls and/or equipment to facilitate and/or inhibit movement of the main clean access platform and/or platform extensions.	As required	Operator failure to facilitate and/or inhibit movement of the main clean access platform and/or platform extensions could result in possible loss (damage) to vehicle/payload.	C	See Hazard Analysis
Output Torque (from air tools used to move platform extensions)	Force to move platform extensions.	As required	Failure to cease and/or improper application of torque from air tools used to move platform extensions could result in possible loss (damage) to vehicle/payload.	C	See FMEA
Stowed CAP platform assembly	Substitutes as PCR zero level flooring for personnel using PGHM	CAP stowed	Failure to properly stow or deploy main CAP platform could result in possible loss (damage) to vehicle/payload.	C	See FMEA
Deployed main platform	Provide work area for personnel and/or equipment.	As required	Loss of work area for personnel and/or equipment could result in loss of life.	C	Passive structure and no FMEA required per NSTS 22206 paragraph 4.4.1.a.6
Extended and/or retracted platform extensions	Provide work area for personnel and/or equipment.	As required	Failure to properly extend and/or retract platform extensions could result in possible loss (damage) to vehicle/payload.	C	See FMEA

Table 3. Criticality Assessment Worksheet – PMN H70-1503					Pages 11 to 11
System/Subsystem: Clean Access Platform & 10-Ton Hoists/10 Ton Hoist RSS Location: Pad A & B					Baseline Number: 422.00
Input/ Output	Function	Time Period	Effect of Loss/Failure If Function Fails to Operate or Cease Operation on Time, Fails During Operation, and/or Prematurely Operates	Crit/ Noncrit	Notes
Input					
50 psi GN2 (from S72-0694-04)	Hazard purge	Continuous	Loss of hazard purge during the presence of explosive gases could result in possible loss of life or vehicle during a hazardous condition.	C	Ref SAA00020
480VAC (from K61-4318-02 @ Pad A & K61-1663-02 @ Pad B)	Power supply for operation of system hoists and associated controls	Continuous	Loss of power supply for operation of system hoists and associated controls would result in loss of capability to operate hoists and/or platform. Operational delay until power restored.	NC	Ref SAA09ELA2-001 & SAA09ELB2-001
Operator input	Manipulates system controls to facilitate and/or inhibit movement of the main clean access platform.	As required	Operator failure to facilitate and/or inhibit movement of the main clean access platform could result in possible loss (damage) to vehicle/payload.	C	See Hazard Analysis
Output					
480VAC	Power used by motor of each of two 10-ton hoists to lift and lower main clean access platform.	As required	Loss of power used by motor of each of two 10-ton hoists to lift and lower main clean access platform would result in loss of capability to lift and lower main clean access platform. Operational delay until power restored.	NC	
120VAC	Power used by electrical controls to facilitate and/or inhibit movement of the main clean access platform.	As required	Premature application of control power to hoist motor brakes could result in possible loss (damage) to vehicle/payload.	C	See FMEA
Torque (to H70-1502)	Force used to lift and lower main clean access platform	As required	Loss of force used to lift and lower main clean access platform could result in uncontrolled movement of platform. Possible loss of life and/or loss (damage) of a vehicle system.	C	See FMEA

4.2 FMEA WORKSHEETS

The Failure Modes and Effects Analysis follows.

The following components were considered passive in the analysis:

- Hook
- Load Block
- Wire Rope
- Rope Drum
- Sheaves
- Structures

4.2.1 Wire Harnesses, Cables and Connectors

Wire harnesses, cables, and connectors were not analyzed in the Electrical FMEA Table(s) since failure of the functions assessed in Section 4.1 for this system do not result in loss of life or vehicle, (Ref. NSTS 22206, Paragraph 4.4.1.b.2).

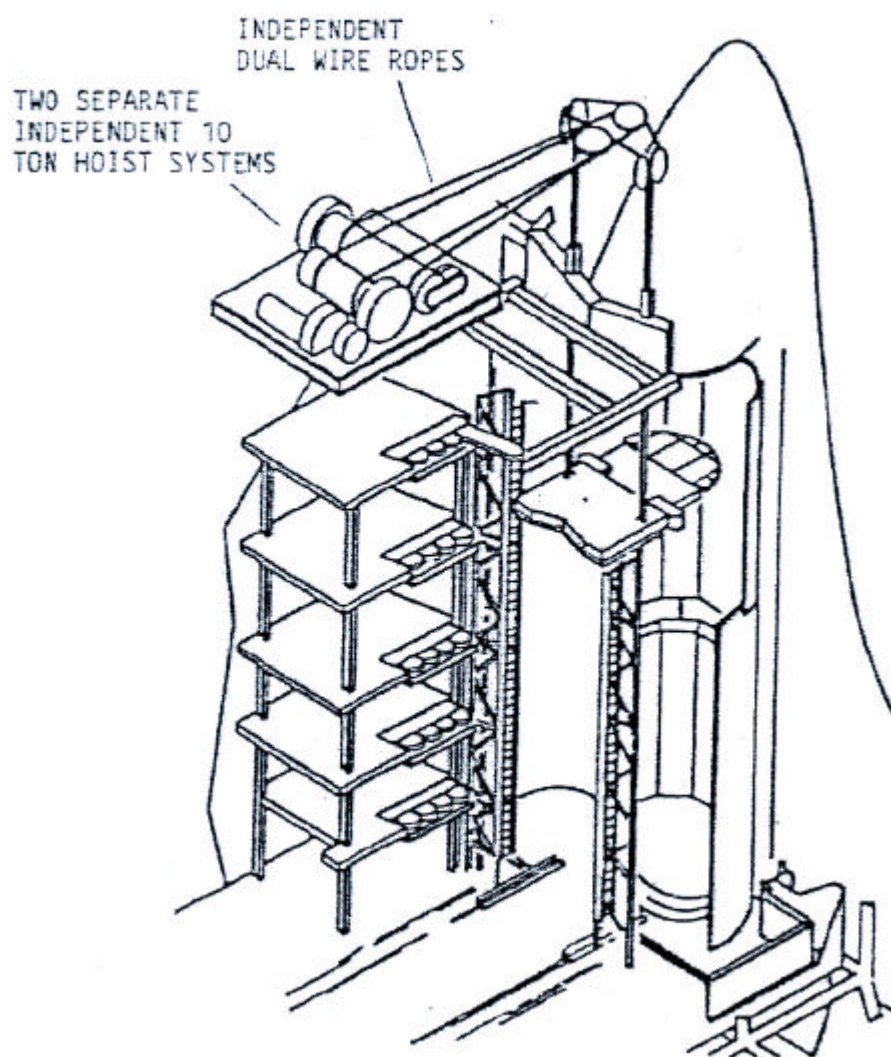


Figure 2. Clean Access Platform and Hoists

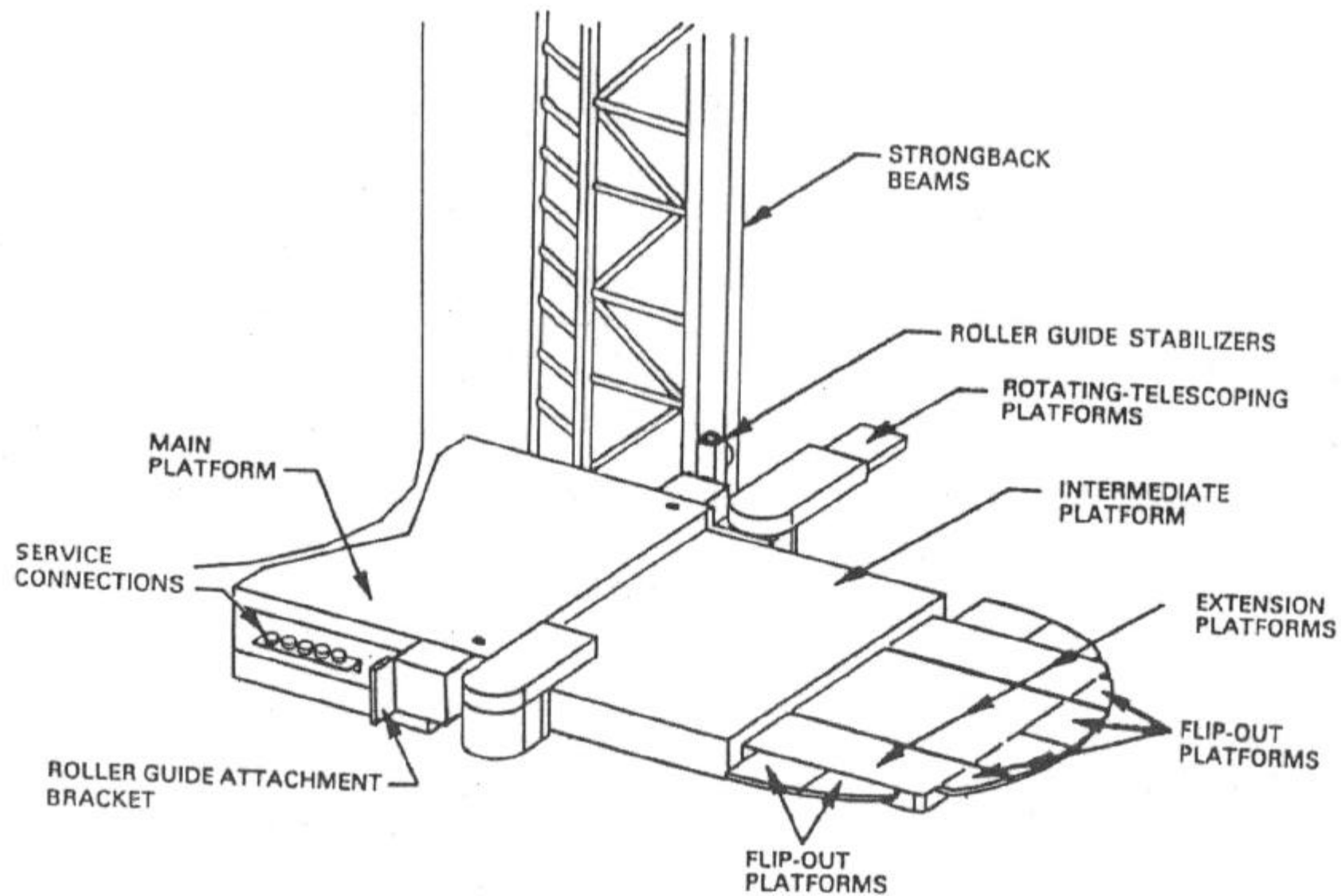


Figure 3. Clean Access Platform Assembly

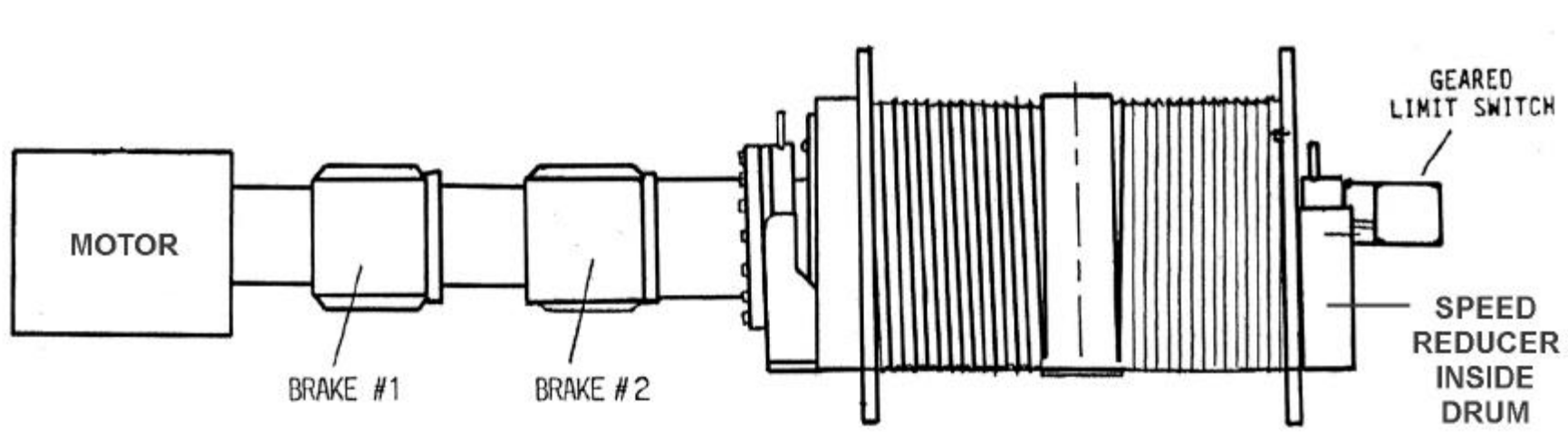


Figure 4. Clean Access Platform Hoist

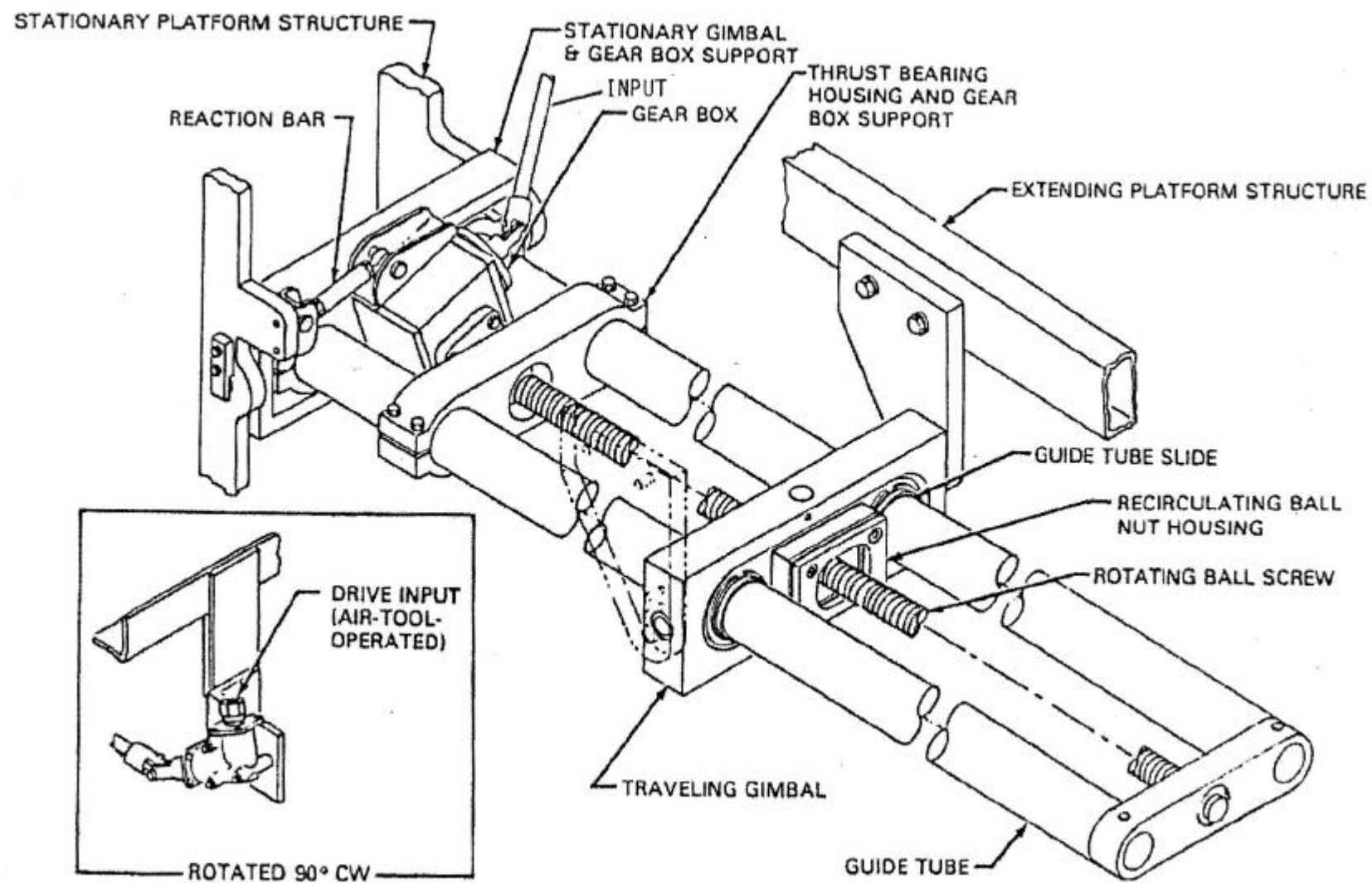


Figure 5. Ball Screw Drive

Table 4. Mechanical FMEA –Clean Access Platform						Pages 17 to 20
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform PMN: H70-1502						Drawing No.: 80K51956 & 80K52848 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
80K51956-22 & 80K52848-28 (1 each 2 total)	Intermediate drive assembly	Provides capability to extend and retract intermediate platform	Ball nut jams	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
			Gear reducer gears jam	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
80K51956-23 & 80K52848-29 (1 each 2 total)	Side finger drive assembly	Provides capability to extend and retract side finger platform	Ball nut jams	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
			Gear reducer gears jam	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
80K51956-24 & 80K52848-30 (1 each 2 total)	Side finger drive assembly	Provides capability to extend and retract side finger platform	Ball nut jams	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
			Gear reducer gears jam	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
80K51956-25 & 80K52848-31 (1 each 2 total)	Center finger drive assembly	Provides capability to extend and retract side finger platform	Ball nut jams	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3

Table 4. Mechanical FMEA –Clean Access Platform						Pages 17 to 20
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform PMN: H70-1502						Drawing No.: 80K51956 & 80K52848 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
80K51956-55 & 80K52848-38 (3 each, 6 total)	Right angle drive (1:1 ratio)	Converts air screwdriver access to plane of a ball screw drive for the center finger and the two side finger platforms.	Gear reducer gears jam	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
			Jams	Cannot extend or retract platform. Delay in operations.	No effect.	3
			Gears disengage	The worm gear speed reducer in the drive train will preclude platform motion. Delay in operations.	No effect.	3
80K51956-60 & 80K52848-39 (14 each, 28 total)	Universal joint	Compensates for in-exact alignment between drive shaft and either right angle drive or gear reducer.	Jams	Cannot extend or retract platform. Delay in operations.	No effect.	3
			Fails disengaged	The worm gear speed reducer in the drive train will preclude platform motion. Delay in operations.	No effect.	3
80K51956-95 & 80K52848-32 (2 each, 4 total)	Anti-backdrive device	Prevents each side finger platform from inadvertently retracting or extending during use.	Jams	Platform will not move. Delay in operations.	No effect.	3

Table 4. Mechanical FMEA –Clean Access Platform						Pages 17 to 20
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform PMN: H70-1502						Drawing No.: 80K51956 & 80K52848 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
80K51956-96 & 80K52848-33 (1 each, 2 total)	Anti-backdrive device	Prevents center finger platform from inadvertently retracting or extending during use.	Fails Disengaged	Two failures required, and the worm gear speed reducer in the drive train will preclude platform motion. Delay in operations.	No effect.	3
			Jams	Platform will not move. Delay in operations.	No effect.	3
			Fails Disengaged	Two failures required, and the worm gear speed reducer in the drive train will preclude platform motion. Delay in operations.	No effect.	3
80K51956-97 & 80K52848-34 (1 each, 2 total)	Anti-backdrive device	Prevents intermediate platform from inadvertently retracting or extending during use.	Jams	Platform will not move. Delay in operations.	No effect.	3
			Fails Disengaged	Two failures required, and the worm gear speed reducer in the drive train will preclude platform motion. Delay in operations.	No effect.	3
80K53239-1	Air screwdriver, 30 in-lbs	Provides rotational drive for linear extension and/or retraction of the intermediate, center finger, or two side finger platforms.	Clutch fails open	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3

Table 4. Mechanical FMEA –Clean Access Platform						Pages 17 to 20
System/Subsystem: Clean Access Platform & 10-Ton Hoists/Clean Access Platform PMN: H70-1502						Drawing No.: 80K51956 & 80K52848 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
80K53239-2	Air screwdriver, 30 in-lbs	Provides rotational drive for linear extension and/or retraction of the intermediate, center finger, or two side finger platforms.	Clutch fails in engaged position	Without operator intervention, platform would continue to move and could damage GSE, payload, and/or vehicle system. The operator can remove air motor off drive point, which would automatically engage anti-back drive device, thereby locking up the drive train and precluding any possible platform motion. No effect.	No effect.	3
			Clutch fails open	Loss of capability to extend or retract platform. Delay in operations.	No effect.	3
			Clutch fails in engaged position	Without operator intervention, platform would continue to move and could damage GSE, payload, and/or vehicle system. The operator can remove air motor off drive point, which would automatically engage anti-back drive device, thereby locking up the drive train and precluding any possible platform motion. No effect.	No effect.	3

Table 5. Mechanical FMEA – Ten Ton Hoists						Pages 21 to 21
System/Subsystem: Clean Access Platform & 10-Ton Hoists/10 Ton Hoist, RSS PMN: H70-1503					Drawing No.: 80K51953 Reference: Fig 4	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
None/ RR2300F	Speed reducer (1 each hoist, 2 hoists per pad, 4 hoists total)	Reduces the motor RPM output and supplies rotational drive to drums for lifting/lowering the Clean Access Platform.	a. Gear disengagement b. Manufacturing defect c. 00013.001 d. Visual e. NA f. NA g. NA	Second hoist would hold and control the Clean Access Platform. Delay in operations until speed reducer replaced.	No effect. Subsequent failure of speed reducer on second hoist would result in total loss of capability for either hoist to support the Clean Access Platform. Possible loss of life or vehicle.	1R
M1	Motor	In parallel with hoist number 2 motor , provides output torque required to raise and/or lower Clean Access Platform.	Inoperative	Slack rope indicator(s) would energize shunt trip solenoid of circuit breaker 3CB1. Operational delay until motor repaired and limit switches reset.	No effect.	3
M2	Motor	In parallel with hoist number 1 motor, provides output torque required to raise and/or lower Clean Access Platform.	Inoperative	Slack rope indicator(s) would energize shunt trip solenoid of circuit breaker 3CB1. Operational delay until motor repaired and limit switches reset.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
1FBR	Relay	Provides capability to disengage brake 1HBA and brake 1HBB for hoist #1 by energizing coil for brake 1HBA and coil for brake 1HBB when fast speed of travel has been selected.	Fail energized	Brake 1HBA and brake 1HBB for hoist #1 would remain disengaged. Brake 2HBA and brake 2HBB for hoist #2 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 1HBA and brake 1HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
1FBR-1	Contact, normally open	Contact closes to provide continuity path to energize coil for brake 1HBA and coil for brake 1HBB to release brakes for hoist #1 when fast speed of travel has been selected.	Fail open	Brake 1HBA and brake 1HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
			Fail closed	Brake 1HBA and brake 1HBB for hoist #1 would remain disengaged. Brake 2HBA and brake 2HBB for hoist #2 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
1HBA	Coil, brake, 120VAC	Causes brake 1HBA to disengage to facilitate hoist #1 capability to raise or lower CAP.	Fail energized	Brake 1HBA would always be disengaged. Series Brake 1HBB would still be engaged. Brake 2HBA and brake 2HBB would also still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 1HBA would remain engaged. Unable to raise or lower CAP until brake (coil) replaced. Operationally delay.	No effect.	3
1HBB	Coil, brake, 120VAC	Causes brake 1HBB to disengage to facilitate hoist #1 capability to raise or lower CAP.	Fail energized	Brake 1HBB would always be disengaged. Series Brake 1HBA would still be engaged. Brake 2HBA and brake 2HBB would also still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 1HBB would remain engaged. Unable to raise or lower CAP until brake (coil) replaced. Operationally delay.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
1SBR	Relay	Provides capability to disengage brake 1HBA and brake 1HBB for hoist #1 by energizing coil for brake 1HBA and coil for brake 1HBB when slow speed of travel has been selected.	Fail energized	Brake 1HBA and brake 1HBB for hoist #1 would remain disengaged. Brake 2HBA and brake 2HBB for hoist #2 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 1HBA and brake 1HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
1SBR-1	Contact, normally open	Contact closes to provide continuity path to energize coil for brake 1HBA and coil for brake 1HBB to release brakes for hoist #1 when slow speed of travel has been selected.	Fail open	Brake 1HBA and brake 1HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
			Fail closed	Brake 1HBA and brake 1HBB for hoist #1 would remain disengaged. Brake 2HBA and brake 2HBB for hoist #2 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
2FBR	Relay	Provides capability to disengage brake 2HBA and brake 2HBB for hoist #2 by energizing coil for brake 2HBA and coil for brake 2HBB when fast speed of travel has been selected.	Fail energized	Brake 2HBA and brake 2HBB for hoist #2 would remain disengaged. Brake 1HBA and brake 1HBB for hoist #1 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 2HBA and brake 2HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
2FBR-1	Contact, normally open	Contact closes to provide continuity path to energize coil for brake 1HBA and coil for brake 1HBB to release brakes for hoist #1 when fast speed of travel has been selected.	Fail open	Brake 2HBA and brake 2HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
			Fail closed	Brake 2HBA and brake 2HBB for hoist #2 would remain disengaged. Brake 1HBA and brake 1HBB for hoist #1 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
2HBA	Coil, brake, 120VAC	Causes brake 2HBA to disengage to facilitate hoist #2 capability to raise or lower CAP.	Fail energized	Brake 2HBA would always be disengaged. Series Brake 2HBB would still be engaged. Brake 1HBA and brake 1HBB would also still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 2HBA would remain engaged. Unable to raise or lower CAP until brake (coil) replaced. Operationally delay.	No effect.	3
2HBB	Coil, brake, 120VAC	Causes brake 2HBB to disengage to facilitate hoist #2 capability to raise or lower CAP.	Fail energized	Brake 2HBB would always be disengaged. Series Brake 2HBA would still be engaged. Brake 1HBA and brake 1HBB would also still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 2HBB would remain engaged. Unable to raise or lower CAP until brake (coil) replaced. Operationally delay.	No effect.	3

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Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
2SBR	Relay	Provides capability to disengage brake 2HBA and brake 2HBB for hoist #2 by energizing coil for brake 2HBA and coil for brake 2HBB when slow speed of travel has been selected.	Fail energized	Brake 2HBA and brake 2HBB for hoist #2 would remain disengaged. Brake 1HBA and brake 1HBB for hoist #1 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3
			Fail de-energized	Brake 2HBA and brake 2HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
2SBR-1	Contact, normally open	Contact closes to provide continuity path to energize coil for brake 1HBA and coil for brake 1HBB to release brakes for hoist #1 when slow speed of travel has been selected.	Fail open	Brake 2HBA and brake 2HBB would remain engaged. Unable to raise or lower CAP until brakes (coils) replaced. Operationally delay.	No effect.	3
			Fail closed	Brake 2HBA and brake 2HBB for hoist #2 would remain disengaged. Brake 1HBA and brake 1HBB for hoist #1 would still be engaged. Any one of the four brakes would be capable of holding the load. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3CB-1	Circuit breaker, solenoid trip/manual reset	Provides capability to inhibit 460VAC supplied from facility power panel P33 to be used by the electrical controls and hoist motors for the CAP.	Premature trip	Lost of 460VAC power to electrical controls and hoist motors for the CAP. Delay in operations.	No effect.	3
			Fail to trip	Lost of capability to inhibit 460VAC supplied from facility power panel P33 to be used by the electrical controls and hoist motors for the CAP. Possibility of damage to GSE.	No effect.	3
			Solenoid fail energized	Lost of 460VAC power to electrical controls and hoist motors for the CAP. Delay in operations.	No effect.	3
			Solenoid fail de-energized	Lost of capability to inhibit 460VAC supplied from facility power panel P33 to be used by the electrical controls and hoist motors for the CAP. Possibility of damage to GSE.	No effect.	3
3F1	Fuse, 10 amp	Provides overload protection for transformer 3T1.	Premature operation	Lost of capability to energize brake coils and release brakes. Neither hoist would be able to move up or down. Delay in operations.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K1	Relay	Provides capability to energize power contactor 3K2.	Fails to operate	Dependent upon fault type and timeframe, possibility of damage to transformer 3T1.	No effect.	3
			Fail de-energized	Lost of capability to energize power contactor 3K2. Brakes would remain set. Delay in operations.	No effect.	3
			Fail energized	Possibility of damage to hoist motors. Possible delay in operations.	No effect.	3
3K1-1	Contact, normally open	Contact closes to energize power contactor 3K2.	Fails open	Lost of capability to energize control system contactor 3K2. Brakes would remain set. Delay in operations.	No effect.	3
			Fails closed	Possibility of damage to hoist motors. Possible delay in operations.	No effect.	3
3K2	Contactor, power	Allows properly phased 460VAC to be supplied in parallel to hoist motor starter switches 1SW1 and 2SW1.	Fail de-energized	Lost of capability to supply 460VAC in parallel to hoist motor starter switches 1SW1 and 2SW1. Delay in operations.	No effect.	3
			Fail energized	Possibility of damage to hoist motors. Possible delay in operations.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K2-1	Contact, normally open	Contact closes to allow phase C of 460VAC power to be supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1.	Fails open	Loss of phase C of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. Phase monitor relay 3PM1 should detect phase loss and inhibit control power to relay 3K1. Delay in operations.	No effect.	3
			Fails closed	Only phase C of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. No effect.	No effect.	3
3K2-2	Contact, normally open	Contact closes to allow phase B of 460VAC power to be supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1.	Fails open	Loss of phase B of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. Phase monitor relay 3PM1 should detect phase loss and inhibit control power to relay 3K1. Delay in operations.	No effect.	3
			Fails closed	Only phase B of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K2-3	Contact, normally open	Contact closes to allow phase A of 460VAC power to be supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1.	Fails open	Loss of phase A of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. Phase monitor relay 3PM1 should detect phase loss and inhibit control power to relay 3K1. Delay in operations.	No effect.	3
			Fails closed	Only phase A of 460VAC supplied in parallel to pole 3 of motor starter switch 1SW1 and 2SW1. No effect.	No effect.	3
3K3	Relay	Provides parallel capability to energize motor starter 1 and motor starter 2 slow speed relay.	Fails de-energized	Lost of capability to operate either hoist at slow speed. Delay in operations.	No effect.	3
			Fails energized	Either the up or the down direction relay would also have to be energized to result in movement. No effect.	No effect.	3
3K3-1	Contact, normally open	Contact closes to provide 120VAC power in parallel to slow speed relay in motor starter 1 and motor starter 2.	Fails open	Lost of capability to operate either hoist at slow speed. Delay in operations.	No effect.	3
			Fails closed	Either the up or the down direction relay would also have to be energized to result in movement. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K3-2	Contact, normally open	Contact closes to provide capability to energize up direction relay 3K5 when slow speed of travel has been selected.	Fails open	Lost of capability to energize up direction relay 3K5 when slow speed of travel has been selected. Delay in operations.	No effect.	3
			Fails closed	Up direction relay 3K5 would also have to fail energized to result in movement. No effect.	No effect.	3
3K3-3	Contact, normally open	Contact closes to provide capability to energize down direction relay 3K6 when slow speed of travel has been selected.	Fails open	Lost of capability to energize down direction relay 3K6 when slow speed of travel has been selected. Delay in operations.	No effect.	3
			Fails closed	Down direction relay 3K6 would also have to fail energized to result in movement. No effect.	No effect.	3
3K4	Relay	Provides parallel capability to energize motor starter 1 and motor starter 2 fast speed relay.	Fails de-energized	Lost of capability to operate either hoist at fast speed. Delay in operations.	No effect.	3
			Fails energized	Either the up or the down direction relay would also have to be energized to result in movement. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K4-1	Contact, normally open	Contact closes to provide 120VAC power in parallel to fast speed relay in motor starter 1 and motor starter 2.	Fails open	Lost of capability to operate either hoist at fast speed. Delay in operations.	No effect.	3
			Fails closed	Either the up or the down direction relay would also have to be energized to result in movement. No effect.	No effect.	3
3K4-2	Contact, normally open	Contact closes to provide capability to energize up direction relay 3K5 when fast speed of travel has been selected.	Fails open	Lost of capability to energize up direction relay 3K5 when fast speed of travel has been selected. Delay in operations.	No effect.	3
			Fails closed	Up direction relay 3K5 would also have to fail energized to result in movement. No effect.	No effect.	3
3K4-3	Contact, normally open	Contact closes to provide capability to energize down direction relay 3K6 when fast speed of travel has been selected.	Fails open	Lost of capability to energize down direction relay 3K6 when fast speed of travel has been selected. Delay in operations.	No effect.	3
			Fails closed	Down direction relay 3K6 would also have to fail energized to result in movement. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K5	Relay	Provides parallel capability to energize motor starter 1 and motor starter 2 up direction relay.	Fails de-energized	Lost of capability to operate either hoist in the up direction. Delay in operations.	No effect.	3
3K5-1	Contact, normally open	Contact closes to provide 120VAC power in parallel to up direction relay in motor starter 1 and motor starter 2.	Fails energized	Either the fast or the slow speed relay would also have to be energized to result in movement. No effect.	No effect.	3
			Fails open	Lost of capability to operate either hoist in the up direction. Delay in operations.	No effect.	3
			Fails closed	Either the fast or the slow speed relay would also have to be energized to result in movement. No effect.	No effect.	3
3K6	Relay	Provides parallel capability to energize motor starter 1 and motor starter 2 down direction relay.	Fails de-energized	Lost of capability to operate either hoist in the down direction. Delay in operations.	No effect.	3
			Fails energized	Either the fast or the slow speed relay would also have to be energized to result in movement. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3K6-1	Contact, normally open	Contact closes to provide 120VAC power in parallel to down direction relay in motor starter 1 and motor starter 2.	Fails open	Lost of capability to operate either hoist in the down direction. Delay in operations.	No effect.	3
			Fails closed	Either the fast or the slow speed relay would also have to be energized to result in movement. No effect.	No effect.	3
3PM1	Phase failure relay	Provides capability to inhibit 120VAC to control system relay 3K1 if 460VAC input power exceeds 15% phase unbalance.	Fails open	Loss of capability to energize control system relay 3K1 and allow 460VAC to be supplied in parallel to hoist motor starter switches 1SW1 and 2SW1. Delay in operations.	No effect.	3
			Fails closed	Possibility of damage to hoist motors. Possible delay in operations.	No effect.	3
3T1	Transformer	Converts 460VAC to 120VAC for use by the electrical control system.	Fails open	Loss of capability to energize control system relay 3K1 and allow 460VAC to be supplied in parallel to hoist motor starter switches 1SW1 and 2SW1. Delay in operations.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
3S1	Switch, disconnect, cabinet	Switch disconnects 480VAC input power when door to power and control distributor is opened.	Fails short	Loss of capability to energize control system relay 3K1 and allow 460VAC to be supplied in parallel to hoist motor starter switches 1SW1 and 2SW1. Delay in operations.	No effect.	3
			Fail open	Loss of 480VAC input power from facility power panel. Operational delay.	No effect.	3
			Fail closed	Loss of capability to disconnect 480VAC input power when door to power and control distributor is opened.	No effect.	3
3S2 (Pad A only)	Switch, disconnect, safety, manual	Provides capability to isolate CAP power and control distributor from 480VAC input power source.	Fails open	Loss of 480VAC input power from facility power panel. Operational delay.	No effect.	3
			Fail closed	Loss of capability to isolate power and control distributor from 480VAC input power. Possibility of damage to GSE.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
H1SRLSB	Limit switch B, slack rope, hoist 1	In parallel with H1SRLSA, provides capability to energize shut trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition.	Fails open Fails closed	H1SRLSA would provide capability to energize shut trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition. No effect. Shunt trip solenoid of circuit breaker 3CB1 would remain energized preventing flow of power to hoist motors or electrical controls. Operational delay.	No effect. No effect.	3 3
H1UGLS	Limit switch, geared, upper, hoist number 1	Switch opens to prohibit capability to energize hoist number 1 and hoist number 2 up relay if hoist number 1 exceeds first preset up travel limitation.	Fails open Fails closed	Loss of capability to energize hoist number 1 and hoist number 2 up relay. Delay in operations until limit switch replaced. Limit switch UTLS would still prohibit capability to energize hoist number 1 and hoist number 2 up relay if either hoist exceeded final preset up travel limitation. Delay in operations until limit switch replaced.	No effect. No effect.	3 3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
H2LGLS	Limit switch, geared, lower, hoist number 2	Switch opens to prohibit capability to energize hoist number 1 and hoist number 2 down relay if hoist number 2 exceeds first preset down travel limitation.	Fails open Fails closed	Loss of capability to energize hoist number 1 and hoist number 2 down relay. Delay in operations until limit switch replaced. Because hoists operate in parallel, limit switch H1LGLS would still open to prohibit capability to energize hoist number 1 and hoist number 2 down relay if both hoist exceeded preset down travel limitation. Possible operational delay.	No effect. No effect.	3 3
H2SRLSA	Limit switch A, slack rope, hoist 2	In parallel with H2SRLSB, provides capability to energize shut trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition.	Fails open Fails closed	H2SRLSB would provide capability to energize shut trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition. No effect. Shunt trip solenoid of circuit breaker 3CB1 would remain energized preventing flow of power to hoist motors or electrical controls. Operational delay.	No effect. No effect.	3 3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503						Drawing No.: 80K51976 & 80K52540 Reference: NA
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
H2SRLSB	Limit switch B, slack rope, hoist 2	In parallel with H2SRLSA, provides capability to energize shut trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition.	Fails open Fails closed	H2SRLSA would provide capability to energize shunt trip solenoid of circuit breaker 3CB1 if either rope on hoist number 1 drum experienced a slack rope condition. No effect. Shunt trip solenoid of circuit breaker 3CB1 would remain energized preventing flow of power to hoist motors or electrical controls. Operational delay.	No effect. No effect.	3 3
H2UGLS	Limit switch, geared, upper, hoist number 2	Switch opens to prohibit capability to energize hoist number 1 and hoist number 2 up relay if hoist number 2 exceeds first preset up travel limitation.	Fails open Fails closed	Loss of capability to energize hoist number 1 and hoist number 2 up relay. Delay in operations until limit switch replaced. Limit switch UTLS would still prohibit capability to energize hoist number 1 and hoist number 2 up relay if either hoist exceeded final preset up travel limitation. Delay in operations until limit switch replaced.	No effect. No effect.	3 3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
HFTLS	Limit switch, full travel	Switch closes to energize shunt trip solenoid of circuit breaker 3CB1 if either hoist number one or hoist number 2 exceeds final pre-set travel limitation.	Fails open	Loss of capability to energize shut trip solenoid of circuit breaker 3CB1 if either hoist number one or hoist number 2 exceeds final pre-set travel limitation. Assumes prior failure of geared limit switch and upper travel limit switch. Multiple failures required. No effect.	No effect.	3
			Fails closed	Shunt trip solenoid of circuit breaker 3CB1 would remain energized prohibiting power to motors and electrical controls. Operational delay until limit switch replaced.	No effect.	3
UTLS	Limit switch, upper travel	Switch opens to prohibit capability to energize hoist number 1 and hoist number 2 up relay if either hoist exceeded final preset up travel limitation.	Fails open	Unable to energize either hoist number 1 or hoist number 2 up relay. Operational delay until limit switch replaced.	No effect.	3
			Fails closed	Loss of capability to de-energize hoist number 1 and hoist number 2 up relay if either hoist exceeded final preset up travel limitation. Assumes prior failure of either H1UGLS or H2UGLS. Double failure required. No effect.	No effect.	3

Table 6. Electrical FMEA – Ten Ton Hoists						Pages 22 to 42
System/Subsystem: Clean Access Platform & 10-Ton Hoists/ 10 Ton Hoist RSS PMN: H70-1503					Drawing No.: 80K51976 & 80K52540 Reference: NA	
Find No. Part No.	Part Name	Part Function	a. Failure Mode b. Cause c. FMN d. Detection Method e. Correcting Action f. Time to Effect g. Timeframe	Failure Effect On System Performance	Failure Effect On Vehicle Systems And/Or Personnel Safety	Crit Cat
None	Switch, dillon, high/low load	Provides capability to energize shunt trip solenoid of circuit breaker 3CB1 if load exceeds maximum weight or if load is less than minimum weight.	Fails closed	Shunt trip solenoid of circuit breaker 3CB1 would remain energized prohibiting power to motors and electrical controls. Operational delay.	No effect.	3
			Fails open	Loss of capability to energize shunt trip solenoid of circuit breaker 3CB1 if load exceeds maximum weight or if load is less than minimum weight. All other limit switches would still be operating properly. No effect.	No effect.	3

4.3 COMPUTER INTERFACE ANALYSIS

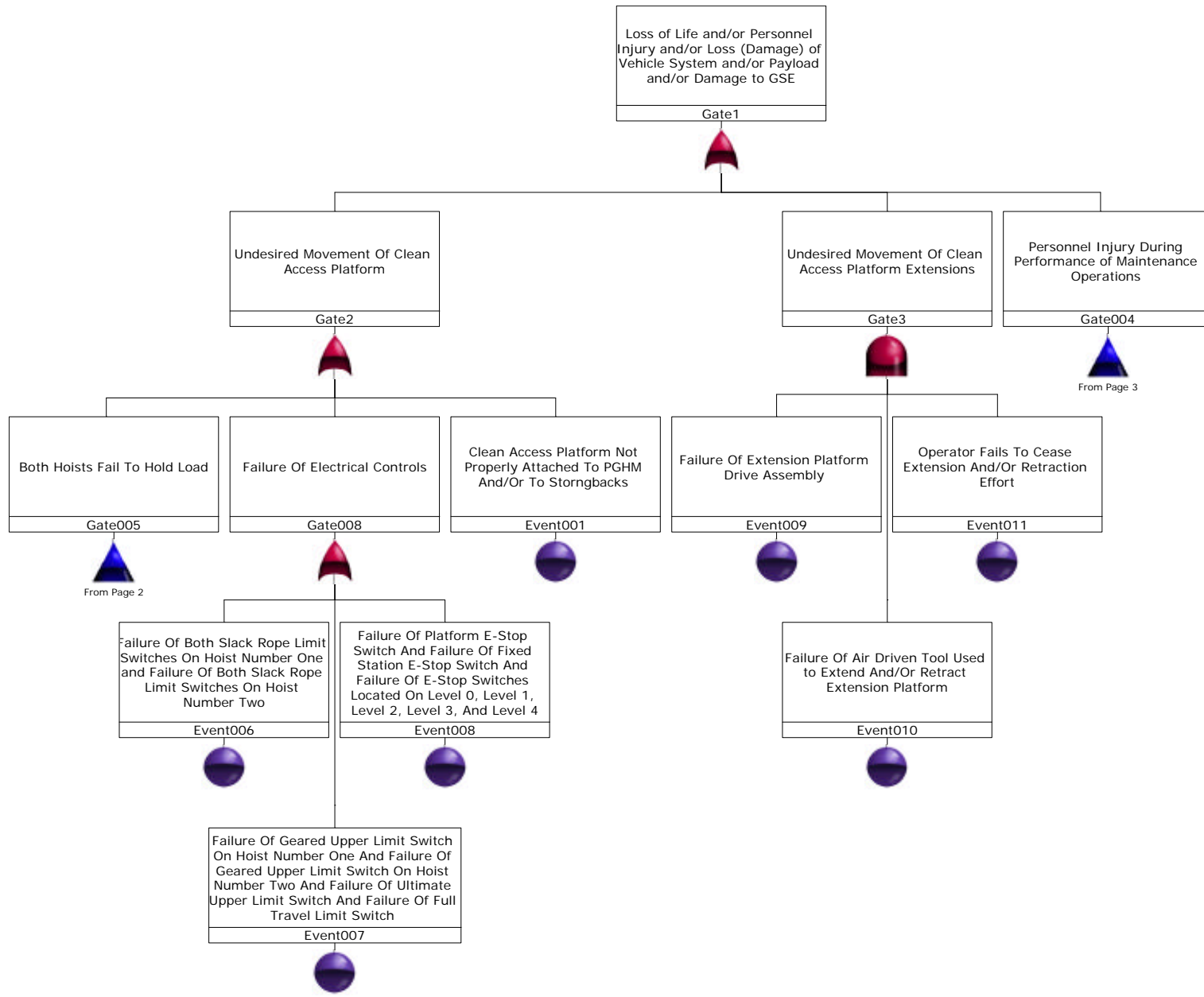
This system does not use an LPS, INCS, or KCCS computer interface for control and/or monitoring of critical system functions identified in Section 4.1.

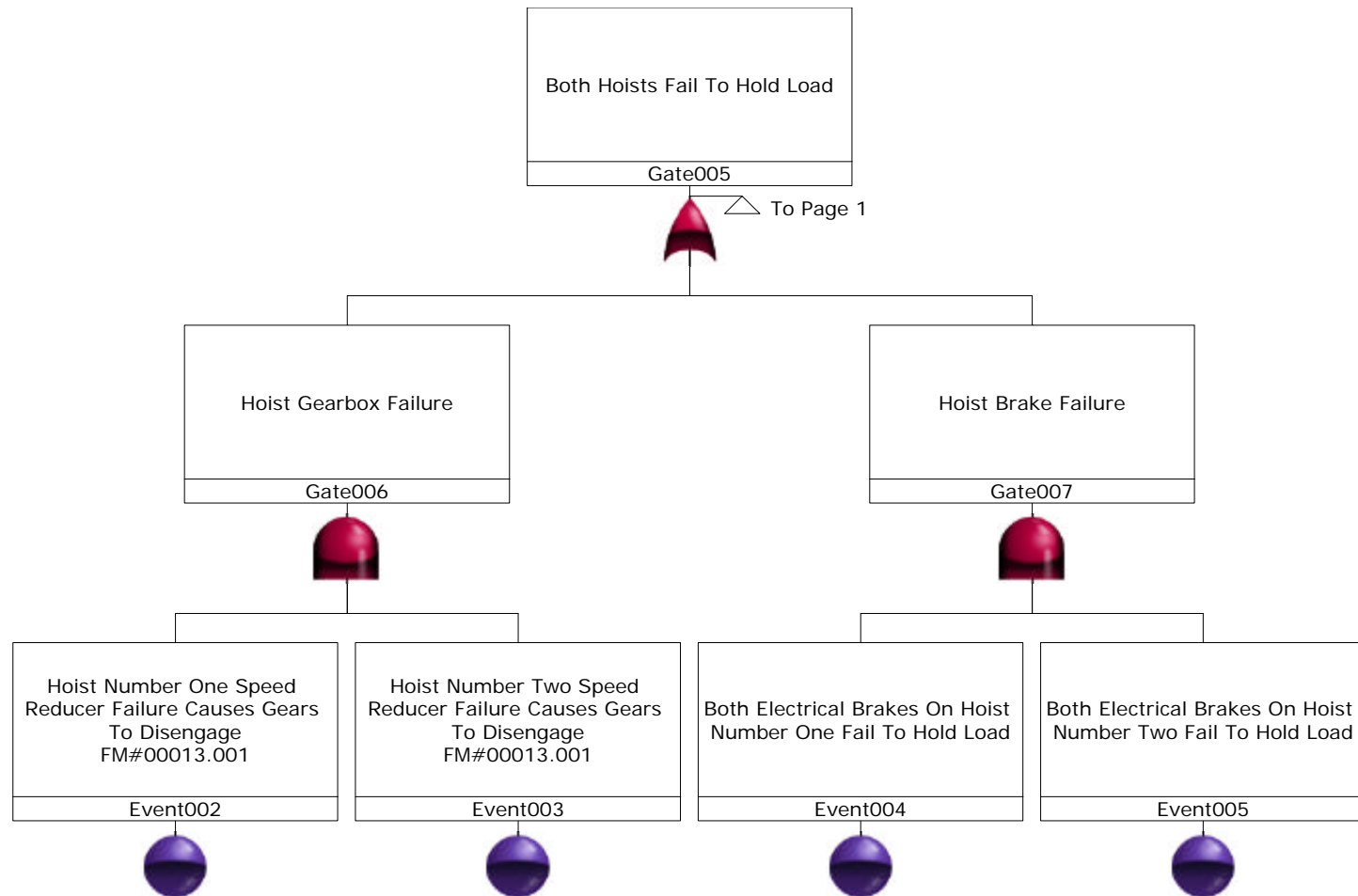
Appendix A. FAULT TREE AND HAZARD ANALYSIS

The Fault Tree Analysis, Hazard Analysis Worksheets follow.

The Hazard Reports associated with this system are listed below.

Shuttle Hazard Reports	
Hazard Report No.	Title
LL-0012	Personnel Required To Perform Work While Beneath Suspended Loads During Flight Hardware Processing At KSC/DFRF/CLS/VAFB
To view Hazard Reports, follow the path; USA Intranet Home Page - Data Warehouse (ADAM) – WebPCASS	





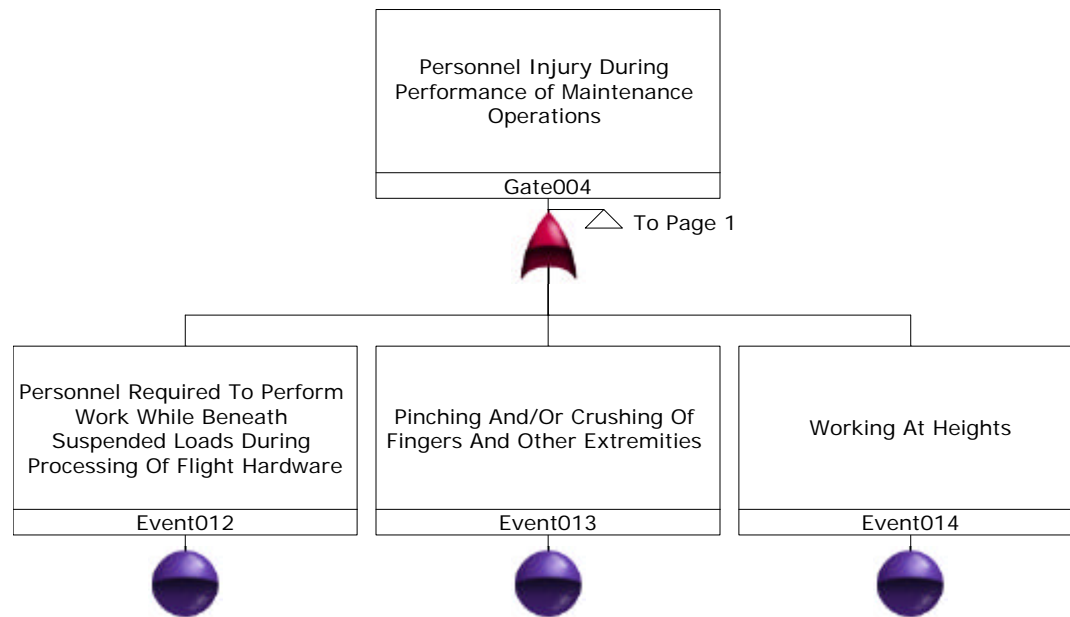


Table 7. Hazard Analysis Worksheet – PMN H70-1502 Clean Access Payload Bay Platform		Pages A-4 to A-4
System/Subsystem: Clean Access Platform & 10-Ton Hoists / Clean Access Platform		Location:
Event No.	Event Nomenclature (Hazard Cause)	Hazard Cause Elimination / Control Verification
E001	Clean Access Platform Not Properly Attached To PGHM And/Or To Strongbacks	OMI V5136 verifies strongbacks are properly connected prior to each use of the CAP. OMI V6H66 performs semi-annual inspections and yearly maintenance to ensure CAP and strongbacks will perform as desired.
E009	Failure Of Extension Platform Drive Assembly	V6H66 performs semi-annual inspections and yearly maintenance to ensure CAP and its extendible platforms will perform as desired.
E010	Failure Of Air Driven Tool Used to Extend And/Or Retract Extension Platform	Annual maintenance performed via OMI V6H66 includes testing/recalibration of air tool clutch ensuring air tool will disengage torque application at 25-35 inch-pounds.
E011	Operator Fails To Cease Extension And/Or Retraction Effort	Annual maintenance performed via OMI V6H66 includes testing/recalibration of air tool clutch ensuring air tool will disengage torque application at 25-35 inch-pounds.
E012	Personnel Required To Perform Work While Beneath Suspended Loads During Processing Of Flight Hardware	In addition to pre-test briefings that inform personnel of the potential hazards associated with performance of this operation, OMI V5136 provides warning number WCLH003 prior to any step that may expose personnel to this type of potentially hazardous situation.
E013	Pinching And/Or Crushing Of Fingers And Other Extremities	In addition to pre-test briefings that inform personnel of the potential hazards associated with performance of this operation, OMI V5136 provides warning number WCLH015 prior to any step that may expose personnel to this type of potentially hazardous situation.
E014	Working At Heights	In addition to pre-test briefings that inform personnel of the potential hazards associated with performance of this operation, OMI V5136 provides warning number WM006 prior to any step that may expose personnel to this type of potentially hazardous situation.

Table 8. Hazard Analysis Worksheet – PMN H70-1503 Pad RSS 10 Ton Hoist		Pages A-5 to A-5
System/Subsystem: Clean Access Platform & 10-Ton Hoists / 10 Ton Hoist RSS		Location:
Event No.	Event Nomenclature (Hazard Cause)	Hazard Cause Elimination / Control Verification
E002	Hoist Number One Speed Reducer Failure Causes Gears To Disengage FM#00013.001	See CIL sheet.
E003	Hoist Number Two Speed Reducer Failure Causes Gears To Disengage FM#00013.001	See CIL sheet.
E004	Both Electrical Brakes On Hoist Number One Fail To Hold Load	OMI Q6173 inspects the brakes as well as the associated components of the electrical control system semi-annually. The OMI also individually tests each of the two electrical brakes annually.
E005	Both Electrical Brakes On Hoist Number Two Fail To Hold Load	OMI Q6173 inspects the brakes as well as the associated components of the electrical control system semi-annually. The OMI also individually tests each of the two electrical brakes annually.
E006	Failure Of Both Slack Rope Limit Switches On Hoist Number One and Failure Of Both Slack Rope Limit Switches On Hoist Number Two	OMI V5136 verifies the proper operation of all CAP limit switches prior to each use of the CAP. OMI Q6173 performs a semi-annual inspection of the associated components of the electrical control system. The OMI also performs an annual test on each of the two slack rope limit switches on each of the two hoists.
E007	Failure Of Geared Upper Limit Switch On Hoist Number One And Failure Of Geared Upper Limit Switch On Hoist Number Two And Failure Of Ultimate Upper Limit Switch And Failure Of Full Travel Limit Switch	OMI V5136 verifies the proper operation of all CAP limit switches prior to each use of the CAP. OMI Q6173 performs a semi-annual inspection of the associated components of the electrical control system. The OMI also performs an annual test on each limit switch.
E008	Failure Of Platform E-Stop Switch And Failure Of Fixed Station E-Stop Switch And Failure Of E-Stop Switches Located On Level 0, Level 1, Level 2, Level 3, And Level 4	OMI V5136 verifies E-stop switches are properly connected prior to each use of the CAP. OMI Q6173 performs a semi-annual inspection of the associated components of the electrical control system. The OMI also performs an annual test of the electrical controls.

Appendix B. CRITICAL ITEMS LIST

USA Ground Operations 1R Non-CIL Sheet**1R Non-CIL Item:** Speed Reducer**Criticality Category:** 1R**NASA Part No:** None**Total Quantity:** 4**Mfg/Part No:** Reggiana / RR2300F**System:** Clean Access Platform & 10-Ton Hoists

Find No.	Qty	Area	PMN	Baseline	Drawing / Sheet
None	2	Pad-A	H70-1503	422.00	71001200 / 1
None	2	Pad-B	H70-1503	422.00	71001200 / 1

Function:

Reduces the motor RPM output and supplies rotational drive to drums for lifting/lowering the CAP platform.

Failure Mode No. Failure Mode	Failure Cause Failure Effect	Detection Method Time to Effect	Crit Cat
00013.001	Manufacturing defect	Visual	1R
Gear disengagement	Second Hoist would hold and control the Clean Access Platform. Subsequent failure of speed reducer on second hoist would result in total loss of capability for either hoist to hold Clean Access Platform. Possible loss of life or vehicle.	N/A	

ACCEPTANCE RATIONALE**Redundancy Screens:****Pass/Fail**

A	Item is verifiable during normal ground operations	Pass
B	Item loss is readily detectable by the ground crew	Pass
C	Loss of all redundant items cannot result from a single cause	Pass

Conforms to NSTS 08080-1: N/A**Test and Inspection:**

OMRS File VI requires annual performance of rated load test.